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October 24, 2018

Mr. Mark Manfredi
Red Hill Regional Program Director
Naval Facilities Hawaii
400 Marshall Road
Joint Base Pearl Harbor Hickam, Hawaii 96860

Re: Comments on interim environmental documents for the Red Hill Bulk Fuel Storage Facility ("Facility") Administrative Order on Consent ("AOC") Statement of Work sections 7.1.3 (Groundwater Flow Model Report) and 7.2.3 (Contaminant Fate and Transport Report).

Dear Mr. Manfredi:

The U.S. Environmental Protection Agency ("EPA") and Hawaii Department of Health ("DOH"), collectively the "Regulatory Agencies", have reviewed *Groundwater Protection and Evaluation Considerations for the Red Hill Bulk Fuel Storage Facility* (dated July 27, 2018) and *Conceptual Site Model, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility* (dated July 27, 2018) developed by the U.S. Department of the Navy ("Navy") and its contractors. These interim documents detail the Navy's comprehensive understanding of the conceptual site model representing the Facility and the surrounding environment, as well as a preliminary model of local and regional groundwater flow.

The Regulatory Agencies continue to believe that some of the interpretations and determinations made in the interim documents are premature or inappropriate after reviewing the supporting data and conducting independent analyses. During in-person meetings August 14- 16, 2018, the Regulatory Agencies' environmental experts gave a presentation on issues of concern related to the interim information that had been made available at that time. We also acknowledge that the Navy has collected and compiled significant quality data for this effort, and the Navy's efforts continue to improve in this regard.

As summarized below, the Navy should address several key aspects of the ongoing environmental investigation and interpretation work.

Supporting materials developed by the Regulatory Agencies' consultants and subject matter experts are provided in the enclosure attached to this letter. The content of the enclosure serves as a basis for these ten issues.

Conceptual Site Model ("CSM")

The CSM should explain all observed data in the field to the extent possible and data that are not incorporated into the model, even if qualified, should be thoughtfully considered. Conceptual and numerical models that best fit available data are critical for technical defensibility of the application of the model to evaluate flow paths and contaminant fate. In particular, the Regulatory Agencies continue to have concerns with the following aspects of the CSM:

- 1) Predominant strike and dip of basalt in the geologic model- The direction and magnitude as represented by the Navy thus far do not reflect the information that has been provided to, or independently evaluated by, the Regulator Agencies. This information is important because it will influence Navy's conclusions regarding groundwater flow paths and transport.
- 2) Saprolite extent in interim model vs. measured depths- The extent of the modeled and measured depths of the saprolite/basalt interface do not agree. In particular, the slope of this interface appears misrepresented in the model, which impacts the flow paths predicted by the interim model.
- 3) Preferential pathways- The consideration and methods of incorporation of preferential pathways in both the CSM and the groundwater model are unclear. Although it is impracticable to precisely characterized these features, they should be explained conceptually and incorporated into the groundwater flow model using appropriate and traceable mathematical representation.

Groundwater Flow Model

Outputs from the groundwater flow model do not comport with measured groundwater gradients in terms of their magnitude, direction, and variability. Several lines of evidence – including measured water levels, organic and inorganic water quality sampling results – suggest occasional gradients, groundwater flow and contaminant migration toward the northwest from tanks located further up the ridge at the Facility. The Navy should address the following aspects of the groundwater flow model:

- 1) Representation of caprock, tuffs and sediments- These features are present in the Navy's narrative of the CSM but are not all incorporated within the interim groundwater flow model in a manner consistent with the CSM. Additional evaluation of how these features may affect gradients, groundwater flows, and transport, should be completed.
- 2) Drinking water shaft inflows- The groundwater flow model does not reproduce the documented distribution of inflows into the Red Hill drinking water shaft and tunnel system. Giving further consideration to conditions observed in Red Hill shaft may improve overall model calibration and reliability in the vicinity and downgradient of the facility.
- 3) Calibration to groundwater heads and gradients- The groundwater flow model does not closely reproduce measured heads and gradients. The final model should prioritize use of the best available groundwater level data reflecting the range of hydraulic gradients under reasonable pumping and non-pumping conditions.

4) Coastal marine boundary and discharge- The coastal discharge rates and patterns in the final groundwater flow model should be discussed with the groundwater modeling subject matter experts, as the over-determination of this boundary condition may reduce model sensitivity to other parameter changes.

Fate and Transport

The *Contaminant Fate and Transport Model Report* required by Red Hill AOC Statement of Work is not due until 180 days after the approval of the *GFM Report* and the *Investigation and Remediation of Releases Report*. Therefore, a *Contaminant Fate and Transport Report* is not anticipated to be completed until the middle of 2020 after our approval of this extension request. As a result, we are providing comments for your consideration in the CSM development and the Navy's longer-term development of the *Contaminant Fate Transport Model Report*. In the short term, we expect conservative contaminant fate and transport considerations to be discussed as a component of the Navy's upcoming tank upgrade proposal at Red Hill.

The Navy's current CSM and statistical LNAPL holding model do not adequately address potential impacts to groundwater from fuel releases, account for LNAPL migration processes, or explain lines of evidence for historical transport observed in the field. Although local characterization data indicates that substantial natural attenuation of hydrocarbons may be occurring, field characterization of the subsurface is highly challenging and impractical in some areas near and around the tanks at the Facility. Therefore, conservative assumptions bounding LNAPL fate and transport or robust, dynamic fate and transport models are critical for long term environmental stewardship. The Navy should address the following issues:

1) Light Non-Aqueous Phase Liquid ("LNAPL") fate and transport- The CSM for LNAPL transport needs to more broadly consider potential rates, directions and distances of LNAPL transport and the primary features and processes affecting that potential transport. The Navy should present the Regulatory Agencies with an approach for developing modeling of LNAPL fate and transport in this environmental setting. The final model should consider potential rates and directions of transport as a function of different types of releases, provide source terms to determine if releases can be captured through pumping, model cumulative effects of releases over time, and utilize incoming field results and new information to calibrate model outputs to observed conditions.

2) Groundwater data- Interpretations of groundwater data from before and following the time of the 2014 release do not adequately consider limited data density and the range of plausible interpretations, including the probability of northerly contaminant transport. Additionally, general water quality indicators including nitrate and dissolved oxygen should be closely examined as lines of evidence for transport and attenuation of past releases.

3) LNAPL and dissolved-phase distribution - The CSM presumes a specific distribution of LNAPL as an outcome of the 2014 release (and prior historical releases), without sufficient data to support this presumption (i.e., the Regulatory Agencies do not view the thermal profile interpretation as definitive). Vapor monitoring data from the time immediately following the release, as well as other historical data suggests other possible distributions may be possible. Based on the data that are currently available, the Regulatory Agencies

believe that a range of possible LNAPL distributions is plausible and the Navy should more closely examine the data and consider the plausible range of migration pathways and timeframes.

We look forward to the upcoming environmental work required as part of the AOC. Please let us know if you have any comments or concerns with the information in this letter.

Sincerely,

Omer Shalev
Project Coordinator
EPA Region 9 Land Division

Roxanne Kwan
Interim Project Coordinator
DOH Solid and Hazardous Waste Branch

Enclosures: Attachment 1- Conceptual Site Model Topics
Attachment 2- Interim Groundwater Flow Model
Attachment 3- Interim Fate and Transport Analyses
Attachment 4- Presentation Slideshow from August 2018

cc: Captain Mark Delao, Navy (via email)
Janice Fukumoto, Navy (via email)